TECHNICAL NOTES

U. S. DEPARTMENT OF AGRICULTURE IOWA STATE OFFICE
NATURAL RESOURCES CONSERVATION SERVICE DES MOINES, IOWA

Agronomy #12

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Subject: ESTIMATING SEVERE EROSION FROM SINGLE STORM EVENTS

After a major storm or a series of storms with heavy rainfall, local and statewide newspapers, radio and TV are interested in reporting damages. District Conservationists, Area Conservationists, and the State Conservationist are expected by the media and the public to have a soil erosion damage estimate of some kind.

Experience has shown us, from statewide front page news accounts in the past, that our reports on severe erosion probably have as much impact as any information we supply to the public. This publicity on severe erosion alerts the average citizen to the fact that we still have serious soil erosion problems. The information is used extensively at the state level when erosion is widespread.

Guidelines for reporting severe erosion are contained in the General Manual under Crisis Responsibilities, Part 403, Subpart A, General.

It can be difficult to make estimates on the extent of severe erosion over a county. This technical note is intended as an aid in estimating county-wide soil losses quickly. These methods may not produce highly accurate information, but will produce estimates a District Conservationist can explain and feel comfortable with, within a short time frame.

For purposes of severe storm reporting, the following assumptions have been made.

1. Severe erosion is defined as exceeding 20 tons/acre/storm. This designation should not be confused with the average annual soil loss values calculated with the Revised Universal Soil Loss Equation Version 2.

2. Erosion estimates as outlined in this procedure reflect only sheet and rill erosion. Separate estimates could be made for ephemeral cropland gullies.

SEVERE EROSION ESTIMATES

Guidelines for estimating number of acres in a county with severe erosion (greater than 20 tons) from a single storm or a series of storms

APPROACH 1

Drive through the county, or part of the county with high rainfall, and make note of the number (percentage) of row crop fields on which you can see sheet and rill erosion. As an example, a 20-ton loss is 1) one rill 1.25" wide and 1.25" deep every foot across a hillside or 2) six rills .5" wide and .5" deep every foot across a hillside or 3) one rill .25" wide and .25" deep every 2" across a hillside. A sheet is attached with more comparisons of varying amounts of erosion.

To check yourself on this visual estimation method, use the attached "Measuring Rill Erosion" method on several fields. Essentially, for purposes of reporting soil losses, when you can see sheet and rill erosion is prevalent on a hillside, soil losses will be in excess of 20 tons per acre.

APPROACH 2

STEP 1. Establish a person in each quarter of the county (commissioner?) who will be able to tell you how much total rain a storm produced, how much of that total fell in the heaviest one-half period, and how widespread the storm was in his area.

STEP 2. Estimate the number of acres of corn and soybeans on Class IIIe and steeper land in the rainfall area. (Extension and FSA should have planting intentions or last year's acreages, if this is not available in the NRCS office. A local NRCS critical erosion area map or soil association map gives a rough estimate of where Class IIIe and steeper land is in the county. Total IIIe and steeper land in the county is available in the soil survey.)

STEP 3. Subtract estimated acres in the rainfall area protected with conservation tillage and terraces. (In cases of extremely heavy rains, these lands may also have losses of greater than 20 tons.)

STEP 4. Most of the land identified from steps 2 and 3 will have shown in excess of 20 tons/acre if the total amount of rain in inches times the amount of rain in the heaviest 30 minutes is 5 or more (1/).

Example: The D.C. in Storm County hears that the northern part of the county had heavy rain last night. He calls two of his rainfall checkers to see how heavy the rain was and how widespread the storm was. Both say the rain lasted most of the night, and they had about 4" of rain in the gauge. They think the cloudburst at the beginning of the rain produced a little over an inch of rain in 30 minutes. Using the formula from step 4, 4"x 1.25" = .5. Most of the unprotected Class III and steeper row crop land in this rainfall area could be expected to have erosion in excess of 20 tons per acre.

From step 2, the D.C. determines the rainfall area had about 120,000 acres planted to corn and beans. Of that, about 80,000 acres were on Class III and steeper land. Of those 80,000 acres, 30,000 were protected with conservation tillage and/or terraces to the extent that erosion was not serious. The estimate for serious erosion, then, is 50,000 acres. The D.C. then drives into the rainfall area to confirm or alter the estimate by first-hand observation, at the same time looking for storm damages to conservation practices and flooding.

Other 1. Since Class IV land is steeper than Class III, the rainfall combination needed in step 4 is a 4 rather than 5.

2. Saturated soil will increase erosion amounts from ensuing rains. After a rainy period, it's especially important to visually check an area because erosion is likely to be more widespread.

3. We're often asked what the erosion losses have been as a result of a series of rains in the spring. In estimating soil losses after several rains, we need to think in terms of accumulative losses. A series of smaller storms in a matter of a couple of weeks may result in as much accumulative erosion as one heavy storm.

4. D.C.'s may be asked how often they would expect a rain to occur like the one they just experienced. That's the purpose of the attached "Storm Frequencies in Iowa."

1/ Developed in consultation with John Laflen, Agricultural Research Service

MEASURING RILL EROSION[1]

BACKGROUND: This method may be used to measure rill erosion which has occurred in a single storm. If representative samples of the rill erosion are used for the measurements, it will provide an accurate figure for the amount of rill erosion per acre.

STEP 1. Pace or measure a lineal distance of 37.5 or 75 feet across the slope in a field.

STEP 2. Measure the width and depth, in inches, of each rill along this distance.

STEP 3. Multiply the width by the depth of each rill, to get a cross sectional area of each rill.

STEP 4. Add the individual areas from step 3 together.

STEP 5. Divide the total from step 4 by 3 if a 37.5-foot distance was chosen or by 4 if a 75-foot distance was chosen. The result is tons of soil loss per acre. This method provides a conservative figure for soil loss, since sheet erosion is not accounted for.

[1] This method is known as the Alutin Rill Erosion Method, originally developed by A.N. Alutin, Soil Conservation Service, Tacoma, WA, and revised in 1981. The revision changes and the length of the sample strip from 42 or 84 feet to 37.5 or 75 feet. The changes were made to this Technical Note in 2006.

VISUALIZING RILL EROSION

BACKGROUND: The average topsoil loss in a year from Iowa cropland is 9.4 tons per acre. That is about 1/16th of an inch spread evenly over an acre. It's also about 6/10 of a cup of soil from a square foot of land. Another comparison is that if that erosion all occurred in a single storm, the rills left would be the equivalent of a rill 9/10" deep and 9/10" wide every foot across the slope.

The chart below shows various soil loss rates and the number and size of rills that would occur in each foot across a slope.

Tons/acre	Number of rills/sq. ft.	size of rill (inches)
3	1	0.5 by 0.5
3	3.7	0.25 by 0.25
5	1	0.6 by 0.6
5	6.2	0.25 by 0.25
10	1	0.9 by 0.9
10	3	0.5 by 0.5
10	12	0.25 by 0.25
20	1	1.25 by 1.25
20	1.6	1.0 by 1.0
20	6.2	0.5 by 0.5
20	24.8	0.25 by 0.25
50	1	2.0 by 2.0
50	3.8	1.0 by 1.0

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STORM FREQUENCIES IN IOWA

Below, in table and chart form, are probable storm (rainfall) frequencies in Iowa. The numbers are averages for Iowa, taken from Technical Paper 40 of the U.S. Weather Bureau.

	STORM DURATION IN HOURS							
	1/2hr.	1hr.	2hr.	3hr.	6hr.	12hr.	24hr.	Storm Frequency
	1	1.30	1.5	1.75	2	2.25	2.75	1
	1.25	1.55	1.85	2	2.25	2.75	3.25	2
Inches	1.6	2	2.30	2.6	3	3.5	4	5
of	1.85	2.30	2.75	3	3.5	4.25	4.5	10
Rain	2.20	2.75	3.25	3.5	4	4.5	5.5	25
	2.4	3	3.5	3.75	4.5	5.25	6	50
	2.75	3.25	4	4.3	5	6	6.5	100

Table 1. Select the column with your storm duration. Then find the amount of rainfall in that period. On the far right, find the frequency you would expect the storm to occur.